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EXAMINER	
REPKO, JASON MICHAEL	

ART UNIT	PAPER NUMBER
2671	

DATE MAILED: 11/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/653,791	OHBA, AKIO	
	Examiner	**Art Unit**	
	Jason M. Repko	2671	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02 September 2003* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: P1-P3 (p. 50, line 10). Furthermore, the drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: 1-3 (*Fig. 21*). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

2. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: Method and apparatus for rendering three-dimensional object groups.

3. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 101

4. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 21-24 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. Claims 21-24 recite a computer program executable by a computer, but not being technologically embodied. To expedite a complete examination of the instant application, the claims rejected under 35 U.S.C 101 as non-statutory subject matter are further rejected as set forth below in anticipation of applicant amending the claims to place them within the four categories of invention.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1-8, 19, 20, 21, and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by applicant's admitted prior art U.S. Patent No. 5,99,189 to Kajiya et al (herein referred to as "Kajiya et al.")

7. With regard to claim 1, Kajiya et al discloses "an image processing apparatus (*Fig. 1 shows an image processing system*) comprising:

a. a grouping unit which groups input three-dimensional objects into groups (*lines 17-20 of column 12: " If processing resources allow, each non-interpenetrating object in*

the scene is assigned to an independent gsprite. Interpenetrating or self-occluding objects may be processed as a single gsprite.");

b. a rendering processing unit which derives a subspace which contains the three-dimensional objects belonging to the same group to be an independent rendering unit and performs rendering processing individually on the subspace, and generates independent image data for each subspace (*lines 18-21 of column 29: "...our system divides objects in a scene among image regions called "chunks" and separately renders object geometries to these chunks."*);

c. and a consolidation unit which generates final output image data to be displayed by consolidating the image data generated for each subspace (*lines 18-24 of column 11: "The gsprite engine 204 operates at video rates to address and decompress the gsprite chunk data and perform the necessary image processing for general affine transformations...After filtering, the resulting pixels (with alpha) are sent to the compositing buffers where display pixel data is calculated."*).

8. With regard to claim 2, Kajiya et al discloses "the rendering processing unit comprises:

d. a coordinate transformation unit which derives a subspace which is a quadrangular truncated pyramid through perspective projection and performs perspective transformation of the three-dimensional object (*lines 36-39 of column 12: "...this process includes transforming bounding volumes of objects to the view space and finding rectangular image regions that enclose the transformed bounding volumes."; 104*);

e. and a rendering unit which performs individual rendering processing in the quadrangular truncated pyramid (*lines 39-41 of column 12: "These image regions define*

the dimensions of the gsprite in terms of the two-dimensional space to which the gsprite's object or objects are rendered."; Fig. 13, 480).

9. Kajiya et al does not use the explicit language "quadrangular truncated pyramid"; however, one of ordinary skill in the art would recognize that a quadrangular truncated pyramid would result from a projective transformation of the bounding volumes to the viewing volume, which is inherent to any image formation, as in lines 36-41 of column 12.

10. With regard to claim 3 and 4, Kajiya et al discloses "the grouping unit groups the three-dimensional objects based on motion characteristics of the three-dimensional objects" (*lines 36-38 of column 10: "The need to update a gsprite can vary depending on object movement, viewpoint movement, lighting changes, and object collisions."; lines 60-63 of column 13: "In addition, some gsprites may not need to be re-rendered or transformed because the object or objects assigned to them have not changed and are not moving."*).

11. With regard to claim 5 and 6, Kajiya et al discloses "the grouping unit groups the three-dimensional objects based on information related to level of detail in rendering the three-dimensional objects" (*lines 26-29 of column 6: "By using gsprite scaling, the level of spatial detail can also be adjusted to match scene priorities. For example, background objects, cloudy sky, etc., can be rendered into a small gsprite (low resolution) which is then scaled to the appropriate size for display."*).

12. With regard to claim 7 and 8, Kajiya et al discloses "the consolidation unit corrects dynamic range of a depth value of each pixel of the image data generated for each subspace" (*lines 39-40 of column 13: "The image preprocessor sorts objects in Z-order, i.e. in distance from the viewpoint."*), "and consolidates the image data by comparing the corrected depth value

and generates the final output image to be displayed" (*lines 40-42 of column 13: "In addition to sorting objects, it sorts gsprites in depth order as well and stores this depth data in the gsprite data structures."*).

13. With regard to claim 19, Kajiya et al discloses "an image processing method comprising dividing a space into subspaces which overlap one another and performing rendering processing independently by subspace unit on a three-dimensional object in each of the subspaces (*lines 18-21 of column 29: "...our system divides objects in a scene among image regions called "chunks" and separately renders object geometries to these chunks."; lines 32-34 of column 7: "In one implementation, the system divides the geometry assigned to gsprites into chunks..."; lines 4-5 of column 58: "...the image regions are overlapping gsprites at non-fixed screen locations..."*), and consolidating rendering data of the three-dimensional object in each of the subspaces by evaluating a distance in depth direction (*lines 40-42 of column 13: "In addition to sorting objects, it sorts gsprites in depth order as well and stores this depth data in the gsprite data structures."; Figure 6 shows determining depth order 280 in preparation for display 298; lines 18-24 of column 11: "The gsprite engine 204 operates at video rates to address and decompress the gsprite chunk data and perform the necessary image processing for general affine transformations...After filtering, the resulting pixels (with alpha) are sent to the compositing buffers where display pixel data is calculated."*).

14. With regard to claim 20, Kajiya et al discloses "an image processing method comprising grouping a plurality of three-dimensional objects into groups and performing rendering processing individually on a subspace which contains at least one of the three-dimensional objects belonging to the same group (*lines 18-21 of column 29: "...our system divides objects in*

a scene among image regions called 'chunks' and separately renders object geometries to these chunks."), and generating final image data to be displayed by consolidating rendering data of each subspace (*lines 18-24 of column 11: "The gsprite engine 204 operates at video rates to address and decompress the gsprite chunk data and perform the necessary image processing for general affine transformations...After filtering, the resulting pixels (with alpha) are sent to the compositing buffers where display pixel data is calculated."*).

15. With regard to claim 21, Kajiya et al discloses: "a computer program executable by a computer (*lines 16-20 of column 9: "These instructions are sometimes referred to as being computer-executed. These aspects of the embodiment can be implemented in a program or programs, comprising a series of instructions stored on a computer-readable medium."*), the program comprising:

f. grouping the three-dimensional objects which exist in a display area into groups (*lines 17-20 of column 12, as shown in the rejection of claim 1*);

g. deriving a subspace which contains the three-dimensional objects belonging to the same group to be an independent rendering unit and performing rendering processing individually by subspace unit to generate image data for each subspace (*lines 18-21 of column 29, as shown in the rejection of claim 1*);

h. and generating final image data to be displayed in the display area by consolidating the image data generated for each subspace (*lines 18-24 of column 11, as shown in the rejection of claim 1*).

16. Although Kajiya et al teaches a plurality of three-dimensional objects, Kajiya et al is silent on array data, as recited in lines 3 and 4 of claim 21. However, this feature is deemed to be

inherent to the object storage as lines 31-33 of column 3 state "the process of generating a display image begins by sorting object geometry for the graphical objects in a scene among image regions called 'chunks.'" The Kajiya et al system would be inoperative if the graphical object data was not an array of graphical object data.

17. With regard to claim 22, Kajiya et al discloses "calculating a position of each of the three-dimensional objects in a viewpoint coordinate system and determining information related to level of detail in rendering each of the three-dimensional objects based on a distance from the viewpoint (*lines 39-42 of column 13: "The image preprocessor sorts objects in Z-order, i.e. in distance from the viewpoint. In addition to sorting objects, it sorts gsprites in depth order as well and stores this depth data in the gsprite data structures."*), and wherein said grouping groups the three-dimensional objects which exist in the display area into the groups according to the information related to level of detail (*lines 26-29 of column 6: "By using gsprite scaling, the level of spatial detail can also be adjusted to match scene priorities. For example, background objects, cloudy sky, etc., can be rendered into a small gsprite (low resolution) which is then scaled to the appropriate size for display."*).

Claim Rejections - 35 USC § 103

18. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

19. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

20. **Claims 9-14, 17, 18, 23 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kajiya et al in view of applicant's admitted prior art Kwan Liu Ma, James S. Painter, Charles D. Hansen, Michael F. Krogh, "A data distributed, parallel algorithm for ray-traced volume rendering," October 25, 1993, Proceedings of the 1993 Symposium on Parallel Rendering, p.15-22 (herein referred to as "Ma et al.")**

21. With regard to claims 9 and 10, Kajiya et al shows the limitations of the parent claims 1 and 2, but does not disclose a distributed system. Ma et al teaches "the rendering processing unit comprises a plurality of rendering units (*first paragraph of section 4: "Currently, the data distributor runs as a single 'host' process that determines the partitions of the data set, reads the data set piece by piece from disk and distributes it to a set of 'node' processes that perform the actual rendering and compositing.*") and distributes the rendering processing to the plurality of the rendering units according to complexity level of the rendering processing by subspace unit" (*third paragraph of section 6: "The data subdivision can be done unevenly, taking into account the predicted capacity on each machine to try to balance the load."*)

22. With regard to claims 11 and 12, the Kajiya et al shows the limitations of parent claims 1 and 2, but does not disclose a distributed system. Ma et al teaches "the rendering processing unit

comprises a plurality of rendering units (*shown in the rejection of claims 9 and 10*) with different processing performance and assigns the rendering processing to the plurality of the rendering units, each of which has the appropriate processing performance corresponding to complexity level of the rendering processing by subspace unit" (*third paragraph of section 6: "Alternatively, the data can be subdivided into larger number of equal sized subvolumes and the more capable machines can be assigned more than one subvolume."*).

23. With regard to claims 13 and 14, Kajiya et al shows the limitations of parent claims 1 and 2, but does not disclose a distributed system. Ma et al teaches "a communication unit which receives image data rendered by subspace unit from an external distributed rendering processing device connected with the apparatus via a network" (*first paragraph of section 3.3: "Each computer can perform ray tracing independently; that is, there is no data communication required during the sub volume rendering."; fourth paragraph of section 3.4: "In our example, as shown in (b), Computer 1 keeps only the left half-image and sends its right half-image to its immediate right sibling, which is Computer 2."*), and "wherein the consolidation unit consolidates the image data received from the external distributed rendering processing device with the image data generated by the rendering processing unit and generates the final output image data to be displayed" (*first paragraph of section 3.4: "The final step of our algorithm is to merge ray segments and thus all partial images into the final total image."*).

24. With regard to claim 17, Kajiya et al discloses "an image processing system including a:

i. a grouping unit which groups input three-dimensional objects into groups (*lines 17-20 of column 12*);

j. a rendering processing unit which derives a subspace which contains the three-dimensional objects belonging to the same group to be an independent rendering unit and performs rendering processing individually on the subspace, and generates independent image data for each subspace (*lines 18-21 of column 29*);

k. and a consolidation unit which generates final output image to be displayed by consolidating the image data generated for each subspace (*lines 18-24 of column 11*).

25. Kajiya et al does not disclose a distributed system. Ma et al teaches "plurality of image processing apparatus for exchanging information with each other via a network and performing distributed rendering processing," (*fourth paragraph of section 3.4: "In our example, as shown in (b), Computer 1 keeps only the left half-image and sends its right half-image to its immediate right sibling, which is Computer 2."; first paragraph of section 4.2: "Thus, using a set of high performance work stations connected by an Ethernet, our goal is to set up a volume rendering facility..."*). Furthermore, Ma et al teaches that grouping, the rendering processing and the consolidation are functionally distributed among the plurality of the image processing apparatus (*first paragraph of section 3.3: "Each computer can perform ray tracing independently; that is, there is no data communication required during the sub volume rendering."; first paragraph of section 4: "Currently, the data distributor runs as a single 'host' process that determines the partitions of the data set, reads the data set piece by piece from disk and distributes it to a set of 'node' processes that perform the actual rendering and compositing.*")

26. With regard to claim 18, Kajiya et al discloses "an image processing apparatus comprising:

l. a grouping unit which groups input three-dimensional objects into groups (*lines 17-20 of column 12*);

m. a rendering processing unit which derives a subspace which contains the three-dimensional objects belonging to the same group to be an independent rendering unit and performs rendering processing individually on the subspace, and generates independent image data for each subspace (*lines 18-21 of column 29*);

n. and a consolidation unit which generates final output image to be displayed by consolidating the image data generated for each subspace (*lines 18-24 of column 11*).

27. Kajiya et al does not disclose a distributed system with distributed functional blocks. Ma et al discloses "an image processing apparatus for exchanging information with other apparatus via a network" (*first paragraph of section 4.2: "Thus, using a set of high performance work stations connected by an Ethernet, our goal is to set up a volume rendering facility... "*) and "processing result by the function block which is not included in this apparatus is received from the other apparatus and utilized" (*first paragraph of section 4: "Currently, the data distributor runs as a single 'host' process that determines the partitions of the data set, reads the data set piece by piece from disk and distributes it to a set of 'node' processes that perform the actual rendering and compositing.*") The data distributor on the "host process" as taught by Ma et al, performs the grouping function, which is separated from and utilized by the rendering and compositing on the "node processes."

28. With regard to claims 23 and 24, Kajiya et al discloses the limitations of parent claims 21 and 22, respectively, but does not disclose a distributed system. Ma et al discloses "the rendering processing are performed in such a manner that the rendering processing for each subspace is

distributed to a plurality of rendering processing units" (*first paragraph of section 4: "Currently, the data distributor runs as a single 'host' process that determines the partitions of the data set, reads the data set piece by piece from disk and distributes it to a set of 'node' processes that perform the actual rendering and compositing."*).

29. Kajiya et al and Ma et al are analogous art because they are from the same field of endeavor/similar problem solving area: computer graphics. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to distribute the grouping unit, rendering processing unit, and consolidation unit disclosed by Kajiya et al across a plurality of image processing apparatuses as taught by Ma et al. The motivation for doing so would have been to accelerate rendering as stated by Ma et al in the first paragraph of section 1. Therefore, it would have been obvious to combine Kajiya et al with Ma et al to obtain the invention specified in claims 9-14, 17, 18, 23 and 24.

30. Claims 15 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kajiya et al in view of Ma et al and in further view of Jerrell Watts, Stephen Taylor, "A Practical Approach to Dynamic Load Balancing," March 1998, IEEE Transactions on Parallel and Distributed Systems, v. 9 n. 3, p. 235-248 (herein referred to as "Watts et al.")

31. With regard to claims 15 and 16, the combination of Kajiya et al and Ma et al shows the limitations of parent claims 13 and 14, respectively, but does not show rendering processing load assigned corresponding to network distance. Watts et al teaches a task is assigned to a plurality of the distributed devices, each of which has different network distance corresponding a task's transfer cost (*fourth paragraph of section 5.2: "In the first case, a task's transfer cost was taken to be the change in the distance from the actual location of its data structures to its proposed*

new location: i.e. the transfer for task i was...where dist is a function which gives the network distance between any two computers..."). One of ordinary skill in the art would recognize that the level of detail is directly related to the amount of data and the transfer cost of the object to be rendered from the statement by Ma et al in the second paragraph of section 6: "For example, a processor tracing through empty space will probably finish before another processor working on a dense section of the data."

32. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the network distance based load balancing method taught by Watts et al to distribute the rendering tasks disclosed by the Kajiya et al and Ma et al system according to transfer cost. Ma et al suggests in the third paragraph of section 6, "Performance of the distributed workstation implementation could be further improved by better load balancing"; thus, the motivation for doing so would have been to improve the performance of the rendering system. Therefore, it would have been obvious to modify the Kajiya et al and Ma et al combination with Watts et al to obtain the invention specified in claims 15 and 16.

Conclusion

33. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. U.S. Patent No. 5,757,385 Narayanaswami et al discloses a system of rendering using multiple processors.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M. Repko whose telephone number is 571-272-8624. The examiner can normally be reached on Monday through Friday 8:30 am -5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on 571-272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JMR

Ulka Chauhan

ULKA J. CHAUHAN
PRIMARY EXAMINER